Yakel engages audience at Duke toxicology seminar

By Simone Otto

NIEHS neurobiologist Jerry Yakel, Ph.D., spoke Feb. 13 at Duke University as part of its Integrated Toxicology and Environmental Health Program spring seminar series.

Yakel's enthusiasm for his research was obvious as he described experiments to demonstrate the mechanics of neuronal excitability and plasticity. (Photo courtesy of Steve McCaw)

In his presentation on "The Role of Nicotinic ACh [Acetylcholine] Receptors in Hippocampal Excitability and Plasticity," Yakel explored the connections between his research as head of the Ion Channel Physiology Group and the environmental public health interests of his audience.

"Nicotine has been used as a basis for many pesticides, and neurons that respond to nicotine have known associations with diseases that include schizophrenia, Parkinson's, and Alzheimer's," Yakel said. "The responses of neurons to nicotine have important implications for both toxicology and environmental issues."

Exploring excitability and plasticity in the brain

To introduce the complexity of neuronal excitability and plasticity, Yakel described the organization of cholinergic input in the brain, the flow of information through the hippocampus, and the nature of synapses, which are the points at which nerve cells pass electrical or chemical signals to other cells. Yakel's research focuses on effects the environment might have on cholinergic neurons and neurons that have cholinergic receptors.

Cholinergic neurons transmit signals to other cells using the neurotransmitter acetylcholine. Cells with receptors that are excited by acetylcholine are also often activated by nicotine, a process the Yakel lab has studied in great detail.

Yakel's presentation drew an attentive audience of students, trainees, and faculty to Field Auditorium at Duke University. (Photo courtesy of Steve McCaw)

The hippocampus, a part of the brain that is important in learning and memory, has a high volume of input from cholinergic neurons and is a primary area of focus for research in the Yakel lab. The group also conducts research on the basal forebrain, the source of cholinergic input into the hippocampus, and an area that is significantly affected in Alzheimer's disease.

In his experiments on excitability and plasticity, Yakel uses electrophysiological techniques to measure the flow of information through these neurons by recording changes in the current passing through them.

Exciting research focuses on the hippocampus

Yakel discussed in some detail three of the exciting areas of research going on in his lab, beginning with studies on how cholinergic neurons modulate hippocampal signaling that are important for memory consolidation.

He also described research into the timing of acetylcholine release into the hippocampus, which is important for strengthening the connection of nerve cells through synapses. This alteration in synaptic strength is the basis of plasticity and allows the brain to respond to a changing environment. This adaptive process can be compromised in disorders such as schizophrenia.

Another area of the lab's focus is the signaling cascade that occurs when an alpha-7 nicotinic acetylcholine receptor is opened. Better understanding of this response could help to identify therapeutic targets for combating neurological and neurodegenerative diseases.

(Simone Otto, Ph.D., is an Intramural Research Training Award fellow with the NIEHS Ion Channel Physiology Group.)

Host Ed Levin, Ph.D., professor of psychiatry at Duke, shared the stage with Yakel during the question and answer session that followed the talk. (Photo courtesy of Steve McCaw)

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